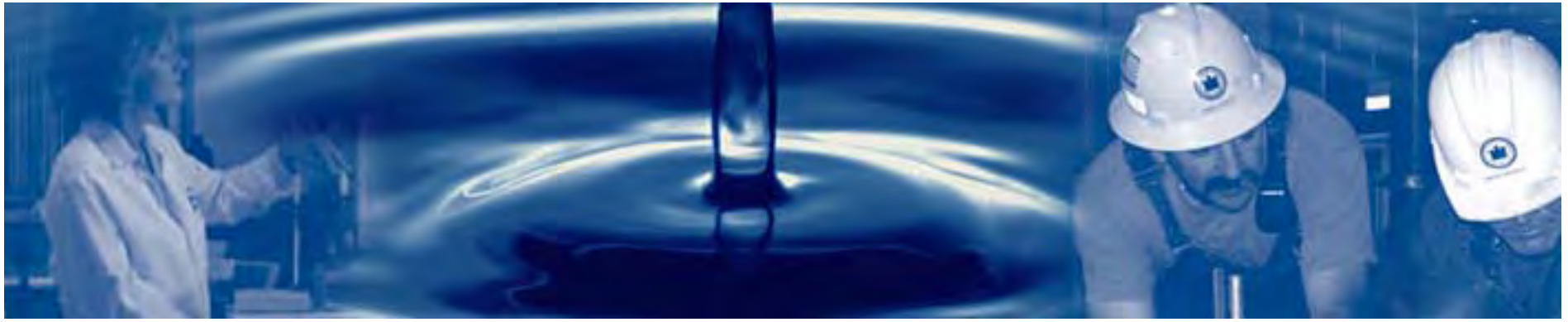
Flow Monitoring



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Comprehensive Planning

King County Department of Natural Resources and Parks
Wastewater Treatment Division

King County

Overview

- Why we need it and how we use it.
- Wastewater Treatment Division (WTD) flow monitors.
- Flow monitoring equipment.
- Flow monitoring process.
  - Field work.
  - Office work.
- Summary: flow monitoring cycle

Why We Need It & How We Use It

- Track long-term trends.
- Conduct hydraulic modeling and calibration.
- Analyze Inflow/infiltration.
- Calculate CSO volume for NPDES reporting.
- Plan inspections and schedule maintenance and repair activities (sonar, CCTV, H2S, relining, pipe sizing for flow bypass).

Why We Need It & How We Use It

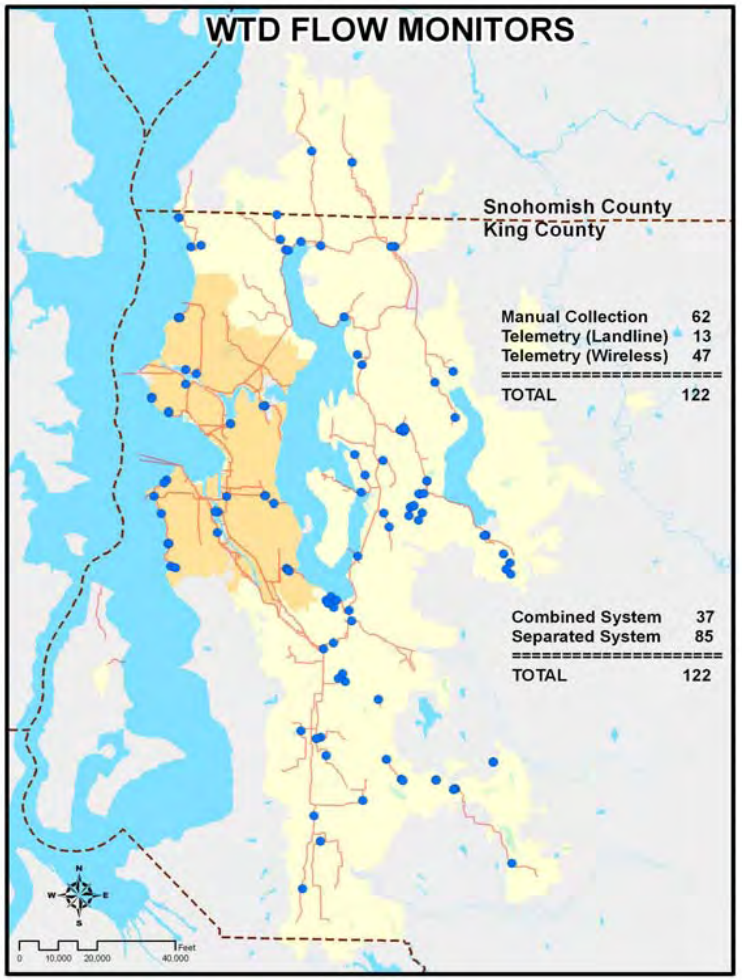
- Analyze conveyance system capacity.
  - Inform design efforts for conveyance and CSO control projects.
  - Review existing capacities, evaluate system.
  - Monitor performance and identify system deficiencies.
  - Identify and quantify additional capacity needs.
  - Prioritize projects and evaluate alternatives.

Flow Monitoring Background

- Pre-2000
  - 90-100 Short and Long-Term (LTM) sites
- 2000 - 2002 KC Regional I/I Control Program
  - 775 - 806 Mini Basins
  - Average Size: 150 Acres, 22,000 LF of Sewer Main
  - 75 Long-Term sites

Current WTD Flow Monitors

- 122 Monitors.
  - Manual collection: 62.
  - Telemetry (landline): 13.
  - Telemetry (wireless): 47.
- 122 Monitors.
  - Combined system: 37.
  - Separated system: 85.



Flow Monitoring Equipment

- Area – Velocity meters (devices that measure velocity and depth for flow rate calculation (Q= A x V))

Meter Type	Depth Sensor	Velocity Sensor
ADS 3600/01 and Flow Shark meters	Ultrasonic/Pressure	Ultrasonic/ Doppler Peak velocity sensor
Marsh McBirney (MMB) FloTote meters	Pressure Transducer	Electromagnetic velocity sensor
Marsh McBirney (MMB) FloDar meters	Ultrasonic/Pressure (only during surcharged conditions)	Radar /Doppler velocity sensor or Electromagnetic sensor during surcharge

Flow Monitoring Process

- Field work
  - Safety.
  - Site investigation.
  - Equipment installation.
  - Field verification.
  - Data collection and record keeping.
- Office work
  - Flow data evaluation and finalization.
  - Troubleshooting equipment/sites.

Field Work: Safety

DANGER

- Traffic control and confined space entry.

- Safe Entry Procedures
- Proper Safety Equipment
  - Harness/Fall Arrestor
  - Gas Meter
  - PPE - Hard hat, Steel Toe Boots

Field Work: Site Investigation

Site Investigation

Project information
- ✓ Project Master list
- ✓ Schematics
- ✓ Site reports

Equipment check
- ✓ Metering equipment
- ✓ Verification equipment
- ✓ Safety & installation tools
- ✓ Supplies including papers pencils, pens etc

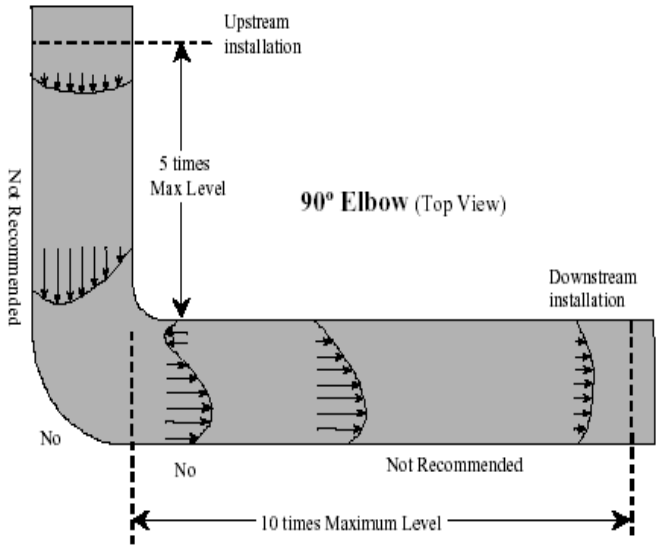
Maps
- ✓City/Sewer maps
- ✓ Resolve unclear information

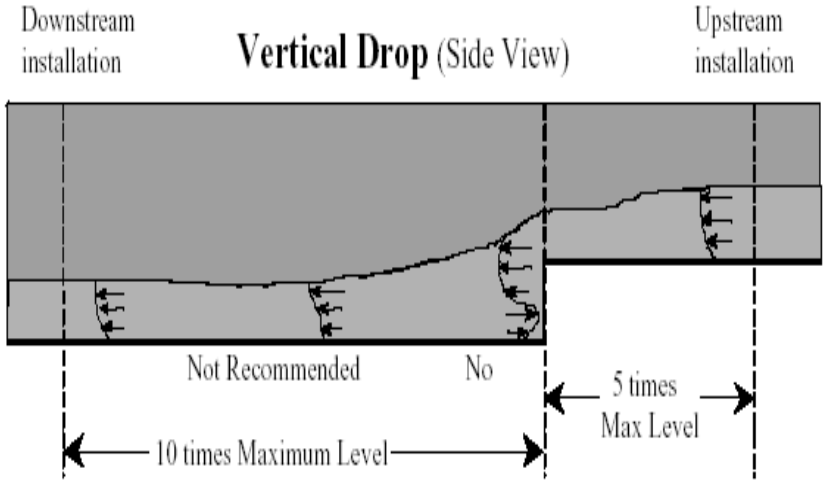
Review potential sites
- ✓ Topside
- ✓ In-manhole
- ✓ Telephone access/wireless service availability

Finalize all information, Install and Verify.

Field Work: Equipment Installation

- Sensor placement—issues to consider:
  - Uniform flow (away from bends and vertical drops).
  - Ease of installation.
  - Ease of access and safety.
  - Extreme velocities.
  - Ease of access to power and telemetry.



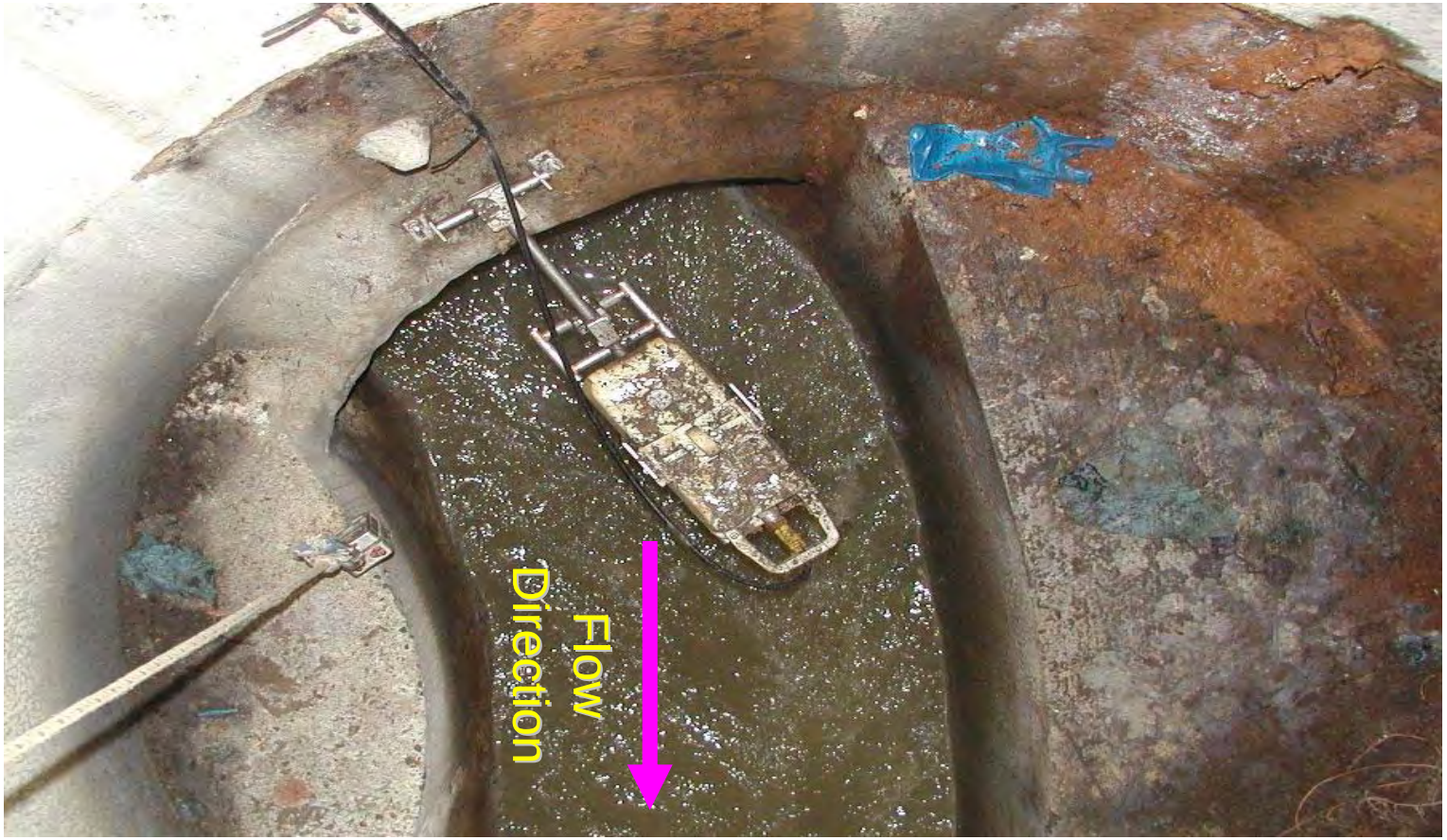


Field Work: Equipment Installation

- Flow meter installation

Field Work: Equipment Installation

- Marsh-McBirney Flo-Dar “permanent” installation



Field Work: Equipment Installation

- ADS 3600/01 and FlowShark installation

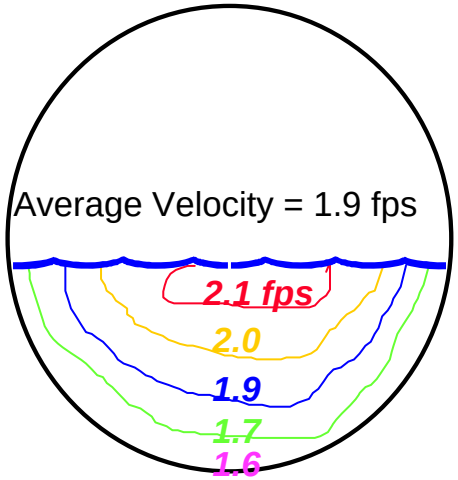
Field Work: Field Verification of Meter Accuracy

- Depth confirmation

Field Work: Field Verification of Meter Accuracy

- Velocity confirmation
  - Flows > 2 inches measured using a portable velocity meter.
  - Low flow (usually < 1 to 2 inches of DOF) using volumetric Weirs or Propeller Meter.

Velocity Profile (> 5 in DOF)



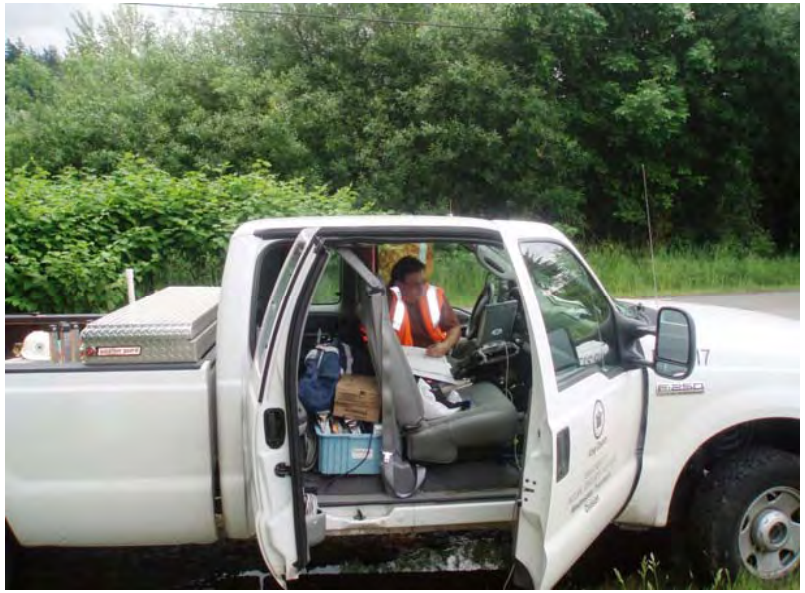
Average to Peak Ratio K

= *1.9 fps/2.1 fps = 0.9*

- slow flow near pipe wall (friction)
- fastest flow near surface and near center
- velocity profile measured by a grid of point velocity measurements

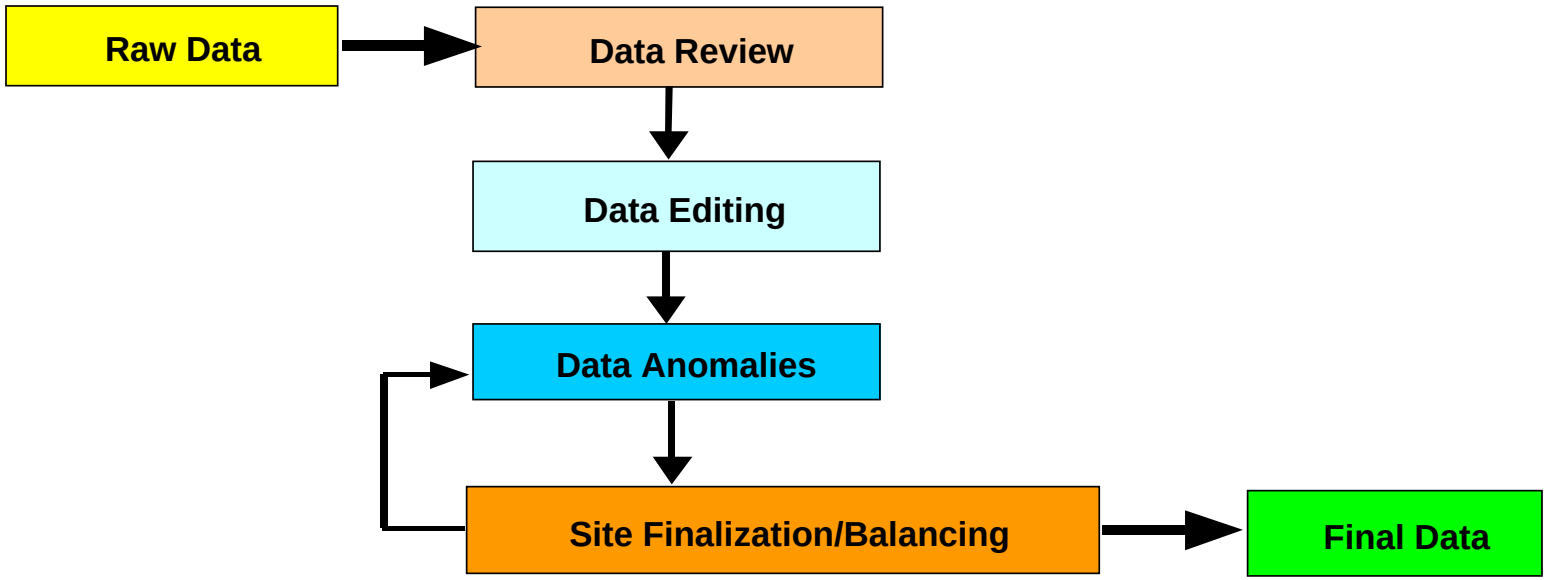
Field Work: Data Collection/Transfer

- Data collected weekly/biweekly using a laptop computer (and remotely from the office).
- Onsite data review (and maintenance).
- Daily data back up to King County server (DNRP/WTD).
- Daily update of site visit logs and verification reports.
- Notify data analyst.



Office Work: Flow Monitoring Data Evaluation

- Raw depth and velocity data are converted to “final” data.

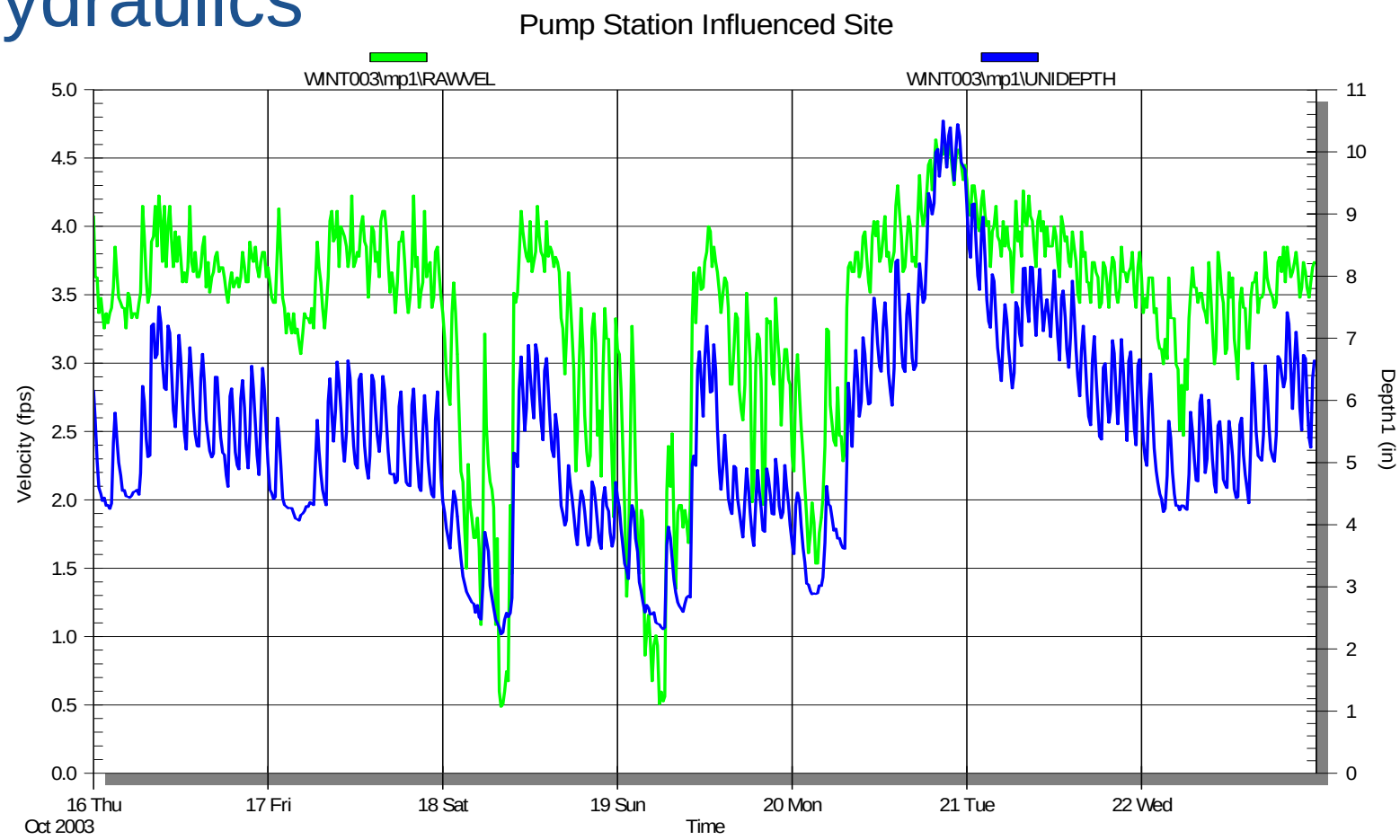


Office Work: Flow Monitoring Data Evaluation

- Review meter functionality and accuracy.
  - Perform diagnostics to verify sensor functionality.
  - Compare meter readings to field readings.
  - Review field notes and any service records.
- Hydrographs and scattergraphs.
  - Compare depth and velocity patterns.
  - Verify consistency with site hydraulics (ex. P/S).
  - Identify sites that have equipment/installation problems.

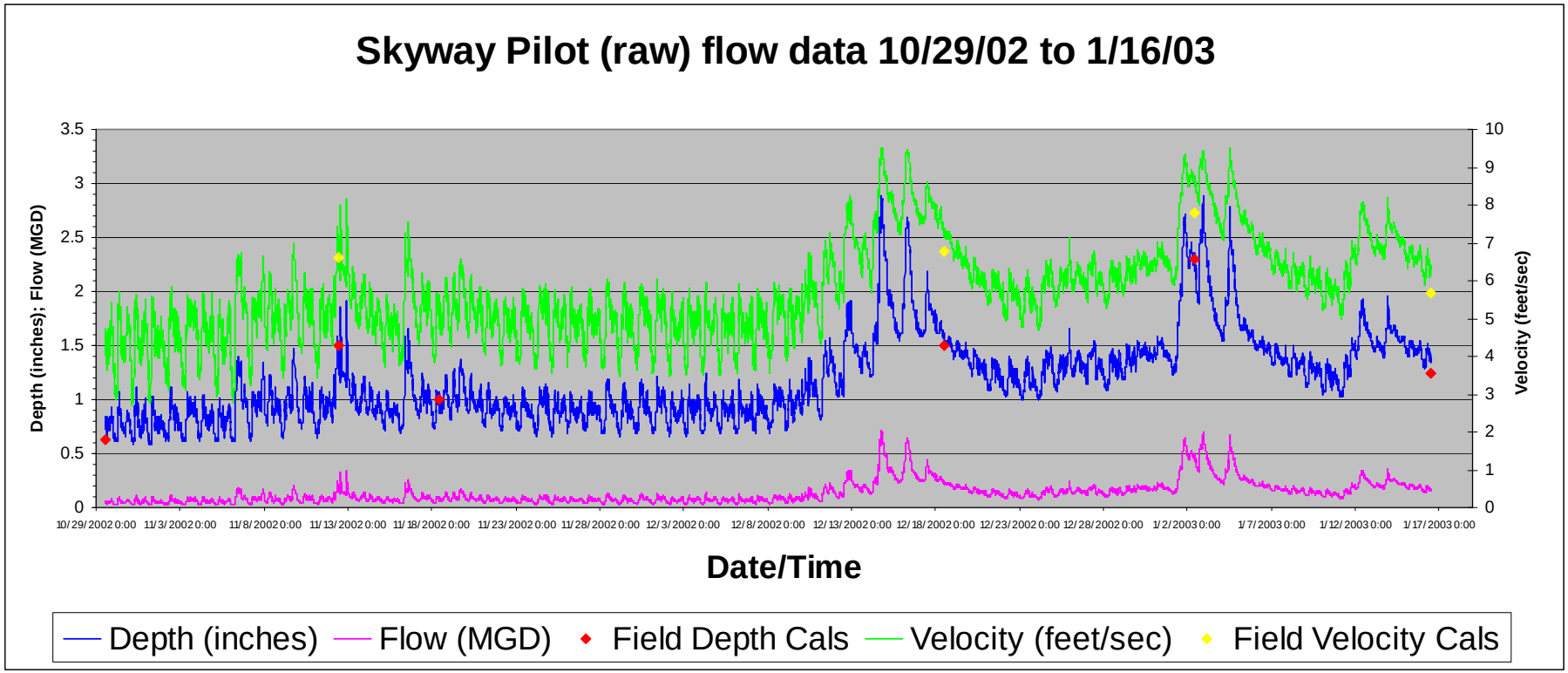
Office Work: Flow Monitoring Data Evaluation

- Hydrograph: consistency with site hydraulics



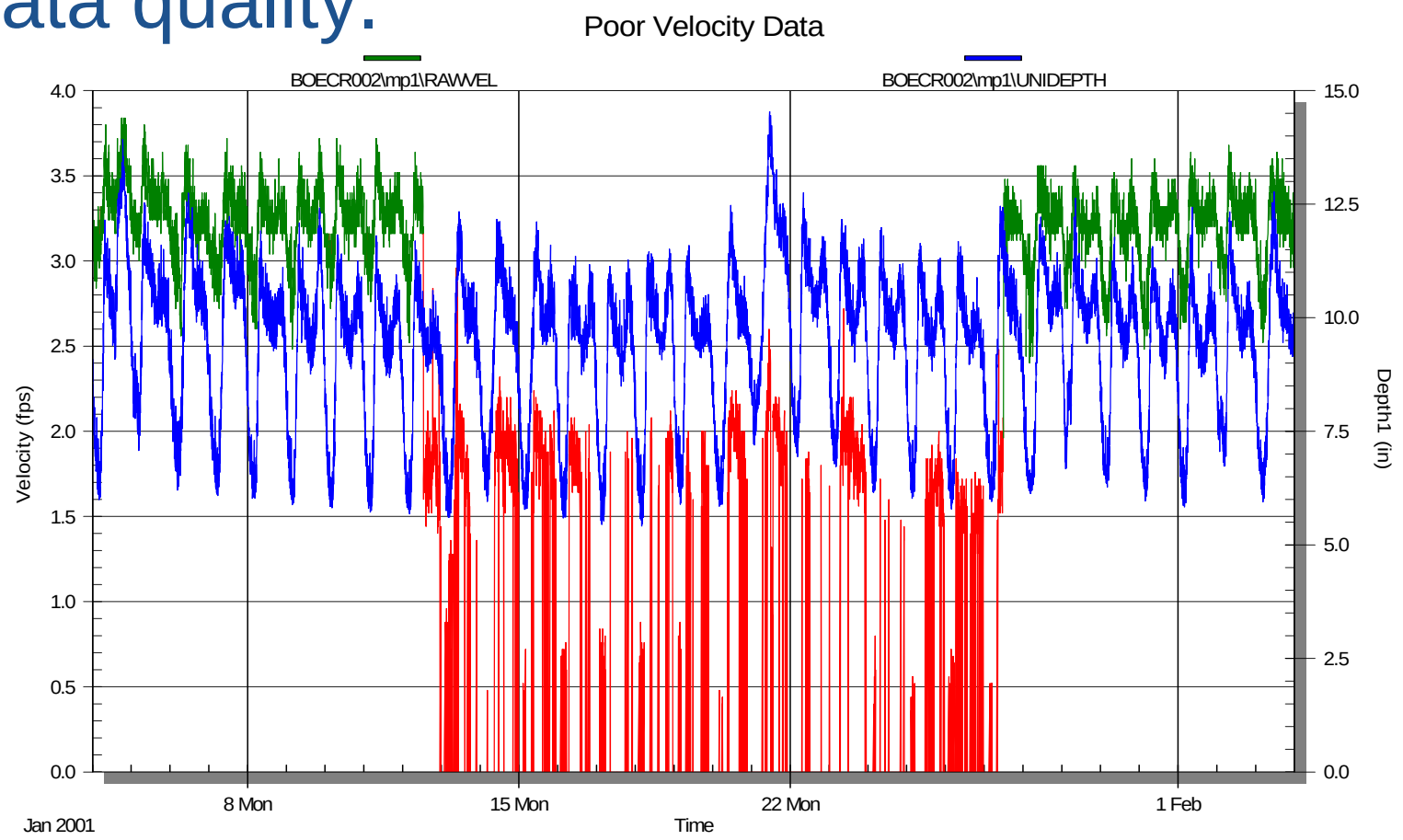
Office Work: Flow Monitoring Data Evaluation

- Hydrograph: compare meter readings to field readings.



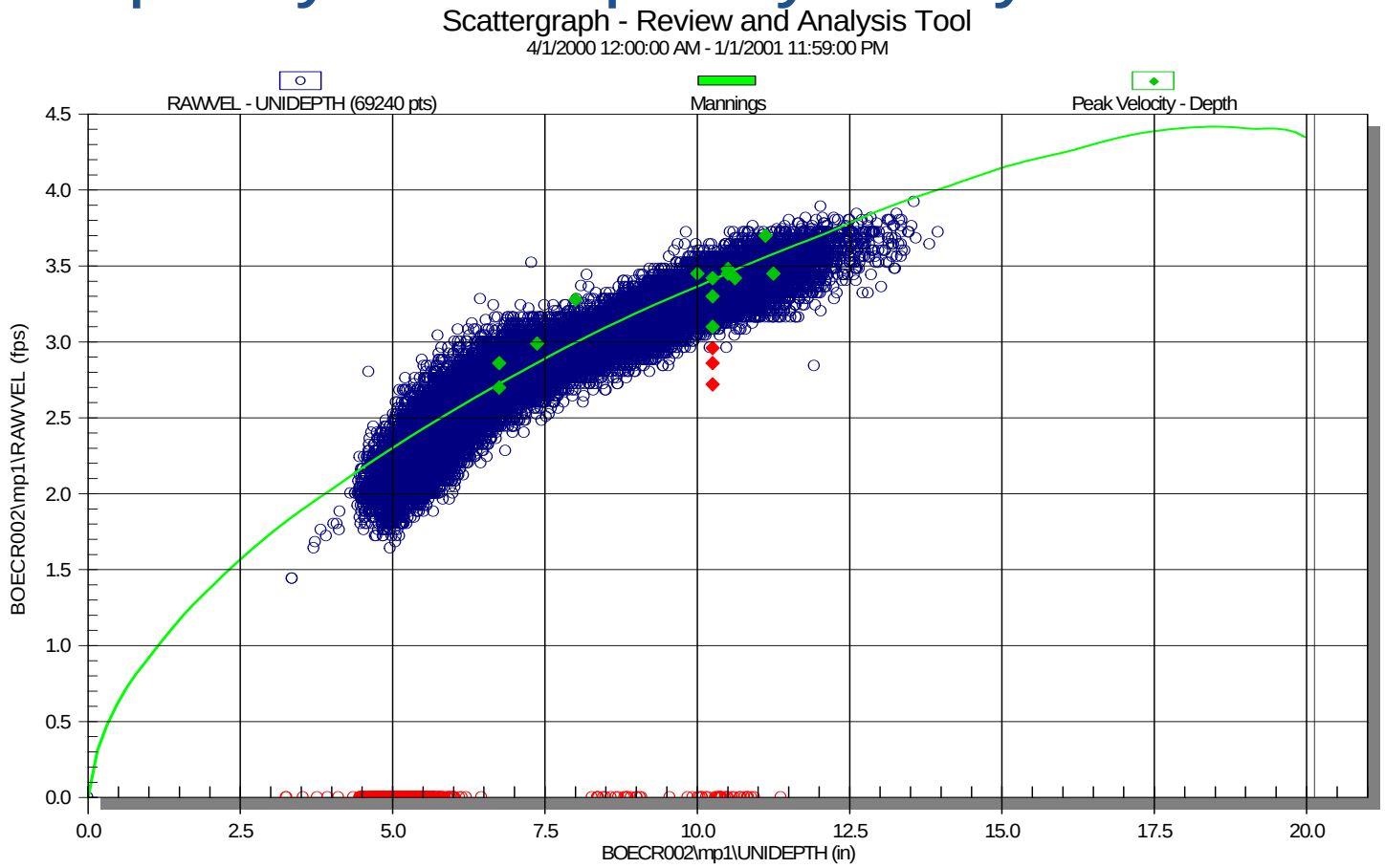
Office Work: Flow Monitoring Data Evaluation

- Hydrograph: verify sensor functionality and data quality.

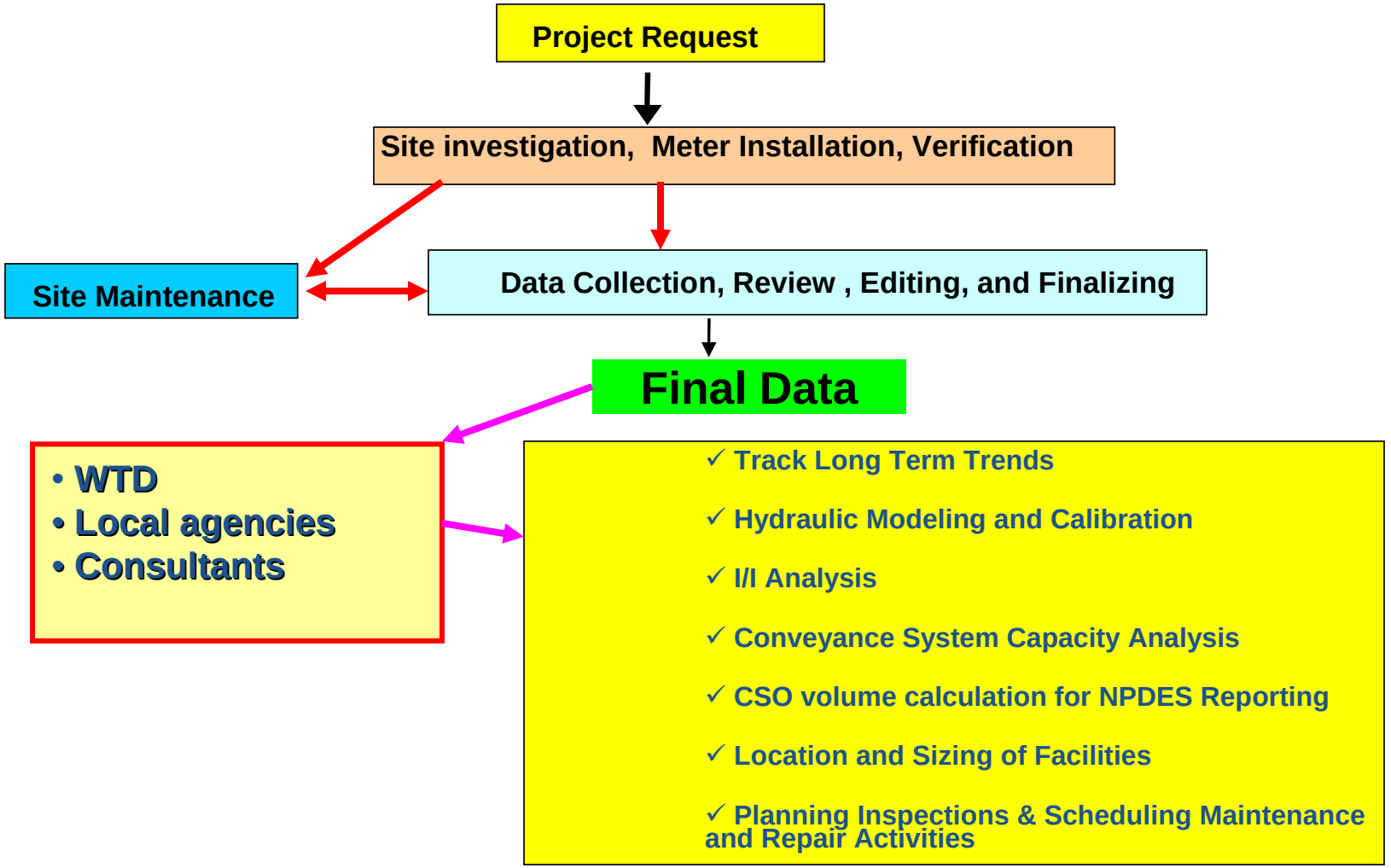


Office Work: Flow Monitoring Data Evaluation

- Scattergraph: verify sensor functionality, data quality and capacity analysis.



Summary: Flow Monitoring Cycle



Contact Information

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Questions?